that his simplification of the presentations of the cranium, so far from being useful, has been productive of great mischief, both theoretically and practically. We trust, therefore, that the talents, industry, and zeal which Dr. L. has so clearly manifested in his pursuit of knowledge will have their legitimate and full reward; and that he, with many co-labourers, will make a complete revision of the mechanism of labour, and thus establish better principles for the guidance of the practitioner. H. L. H.

ART. XVI.—*Gunshot Wounds and other Injuries of Nerves.* By S. WEIR MITCHELL, M. D., GEORGE R. MOREHOUSE, M. D., and WILLIAM W. KEEN, M. D., Acting Assistant Surgeons U. S. A., &c. 12mo. pp. 164. Philadelphia: J. B. Lippincott & Co., 1864.

Reflex Paralysis. Circular No. 6, Surgeon-General's office, March 10th, 1864. By A. A. Surgeons S. W. MITCHELL, G. R. MOREHOUSE, and W. W. KEEN, U. S. A. pp. 17.

Lectures on the Physiology and Pathology of the Nervous System. By C. E. BROWN-SÉQUARD, M. D., F. R. S., Fellow of the Royal College of Physicians of London, &c. &c. Philadelphia: J. B. Lippincott & Co., 1860.

Clinical Observations on Functional Nervous Disorders. By C. HANDFIELD JONES, M. B., &c. pp. 585. London: 1864.

ONE of the many important improvements introduced into the Medical Department of the United States army during the Surgeon-Generalship of Dr. Wm. A. Hammond, was the establishment of a number of special hospitals, for the treatment of certain classes of cases. Not only has the particular experience and skill thus acquired proved beneficial to the patients under care, but science has profited by the concentrated and prolonged observation of facts thus made possible; facts, many of which might otherwise have been lost for want of comparison and record.

Diseases and injuries affecting the nervous system are especially worthy of such specialization, because of their importance, and of the rarity with which lesions of the nerves have been made the subjects of clinical study. The great text-books of Military Surgery refer but briefly to injuries of the nerves; none, in the English language, at least, giving any systematic account of them, or dealing satisfactorily with their treatment.

The authors of the two *brochures* whose titles are placed first above, have made industrious use of the opportunities afforded them. The special labours and studies of whose results they give account, began in May, 1863; and embrace the history of about one hundred and twenty cases, all of whose details had been carefully reported in the note-books of the hospital. The topics dwelt upon are, chiefly, wounds of nerve centres, wounds of nerve trunks, or their branches, and the resulting alterations in nutrition, sensation, motion, calorification, &c., and the treatment of nerve lesions.

Unfortunately, it is often impossible to determine exactly the amount of injury sustained by a nerve or nerves. The nerve whose distribution finally remains affected, must be inferred to be the one principally involved in a wound, the precise nature of which is not capable of inspection, especially in a hospital to which the patients are not brought directly from the field. Forty-eight cases of severe gunshot wounds of nerves were selected by Dr. Mitchell and his collaborators, to study the *immediate* effects of such injuries. Most of them involved the nerves of the upper or lower extremities. Of thirty-one not wounded in the lower limbs, seven fell instantly, unconscious; only one of these bleeding largely. None of the twelve who fell with wounds of the legs became unconscious. Fourteen of the eighteen wounded in the arm continued standing; two became senseless; and two fell but remained conscious. Of those wounded in the neck or axilla, one fell senseless, four fell conscious, and eight did not fall. A general and nearly instantaneous weakness, or *shock*, was felt by almost every one of the whole number. It is to be inferred that the shock from a nerve-wound is likely to be most severe in wounds about the upper third of the body.

Loss of motion was total, in the limb affected, in thirty-two cases; of which some had entire, and others partial loss of sensation also. A difficult fact to explain is, the great frequency with which a gunshot injury of a nerve causes total loss of motion and very little of sensation; as if the sensitive filaments might be less susceptible to foreign impressions; a conclusion which our authors naturally hesitate to adopt. Acute pain, elsewhere than in the wound, was rare as an early symptom of nerve lesions.

Of wounds of nerve centres, we have the fullest account of those involving the spinal marrow. In the first case narrated at length, one point of interest is, the "marvellous success" of the treatment of bedsores, by Brown-Séquard's plan, of applying alternately, for ten minutes or more at a time, iced water and hot poultices. Referring to the lectures of this distinguished writer (p. 260), we find his theory upon the subject to be, that *nervous irritation*, acting upon the bloodvessels, and thus disturbing nutrition, is the cause of sloughing from fractures of the spine. Without entering upon the discussion of this theory at present, it may be remarked, that the success of the practice has no necessary dependence at all upon the correctness of the rationale asserted for it. If bedsores be, as has been more commonly supposed, due not to an irritative, but to a *paralytic* affection of local nutrition, the means used to make strong and varied impressions upon the part may be expected, upon this view, quite as well as upon the other, to be beneficial. The second case of spinal lesion, in the Christian Street Hospital, afforded the agreeable result of a rapid and complete recovery, from considerable paralysis of one arm following a wound of the neck, after a tooth (which pressed upon the tongue) and the ball, which had lodged in the body of the third vertebra, had been removed.

Spinal commotion is described as being not at all uncommon in the experience of our surgeons; although similar cases are rare in the works of authors on military surgery. A ball passing over or alongside of the spine causes, without fracture, or with merely a chipping of the spinous processes, a paralysis of one or more members; which may be as severe and obstinate as in any case of fracture. Violent commotion of the nerves, where they pass out of the intervertebral spaces, is very reasonably supposed to account for the more permanent of these effects. In a few cases, doubt may be entertained whether the diagnosis should be of spinal commotion or of reflex paralysis. When the ball has passed over a region containing no large nerve trunks, and but few sensory filaments, the former may be concluded upon, if the missile came in contact with the spinal column. A minié ball may "radiate" its effects upon tissues, to a distance of an inch, at least.

Exquisite *muscular hyperæsthesia* was remarkable in one case, but occurred prominently in several examples of contusion of the lower part of the spine; sometimes with cutaneous hyperæsthesia also.

One wound of the sympathetic nerve, only, has presented itself to Drs. Mitchell, Morehouse, and Keen. That it was of that nature was inferred, without possibility of demonstration, as the patient recovered. The ball entered the right side of the neck, and went out near the angle of the left jaw. The right pupil was very small, the left unusually large; ptosis of the right eye also occurred; and that eye appeared rather smaller than the other. After exercise, the right side of the face became flushed, while the left was pale; no difference in the temperature of the two sides was discovered during repose, on careful thermometric examination within the mouth and ear. Another hypothesis than that of wound of the sympathetic is alluded to, as suggested by facts made known by Budge, Waller, and Brown-Séquard, as to the relations of the eye with the cilio-spinal portion of the cord; extending, according to the last-named observer, as low as the tenth dorsal vertebra. No evidences of spinal shock, however, existed in the case described.

A single case of wound of the fifth pair was treated by our authors. Reflex paralysis of the left arm followed, cured by electricity. Of the *portio dura* of the seventh pair, three cases are mentioned, with interesting details. In one of them, taste was greatly impaired on the side of the tongue corresponding with the injury. Facial motor paralysis was marked in all.

In the fifth chapter of the treatise we have been so far following, injuries of nerve trunks are thus classified: Direct injury of nerve trunks by a missile; commotion from the near passage of a missile; contusion, as from a blow; injury from dislocation, or from attempts at its reduction; cicatrix pressure; extension of diseased processes from wounded nerves to those which are healthy.

Contusions of nerves, being common in civil practice, are referred to as having been best studied by M. Duchenne. Rarely grave in their first effects, severe blows upon nerves are prone to give rise to ultimate consequences as fatal to functions as those which arise directly from a ball wound itself. Not dissimilar from these are those obscure accidents to the brachial nerves which sometimes arise from dislocations of the humerus or attempts at reduction. Among the points of interest brought out are, that atrophy from contusion of a nerve may involve only certain fibres of a muscle and respect the rest; and that atrophy is sometimes accompanied by a contracted state of the muscle.

Pressure upon nerve trunks by cicatrices in which they are involved, was seen by our authors, chiefly in superficial shell wounds. Sometimes the position of a limb had an important influence upon the nerve so involved.

Of the last class of cases above enumerated—where extension of disease is traced from the site of injury along the nerve trunks to others which become likewise affected—Drs. Mitchell, Morehouse and Keen treat somewhat fully; as, in their words, "the view taken of them is in some degree novel, and just such cases have, as we suppose, been misunderstood by at least one very distinguished observer" (Duchenne).

Two striking instances are narrated in detail, showing that, a nerve being injured, other trunks of the parent plexus may become secondarily affected. Two explanations are open—that of a "reflex effect," and the theory that inflammation originating at the wound travels backward along the hurt nerve, and falls on one or more stems of the main trunks. Duchenne adopts the former view; using the expression that "there exists a sort of *solidarité* between all the nerves of a limb, so that no one can be suddenly destroyed without compromising the general innervation of the limb." Our authors prefer the other theory; but, it appears to us, upon slender evidence. Clinical accounts of extended inflammation of nerve trunks are not afforded, even in their own reports, such as to enable us to diagnose such a morbid process satisfactorily; and, whatever be the theory accepted to explain reflex paralysis, the cases referred to would seem to belong to that category.

The very remarkable effects of wounds of nerves upon the nutrition of parts are declared, by the authors of the treatise before us, to have found no full record anywhere—Duchenne saying more of them than any other writer—while the vivisections of the physiologists have supplied some interesting facts.

Atrophy of the muscles is among the most marked of these effects, either total in a muscle or series of muscles, or affecting a lateral or longitudinal part of one. In rare cases the muscle, palsied as to motion, has scarcely seemed to lose bulk at all. In such examples, the electro-muscular contractility is sometimes intact, sometimes lessened. *Contraction* may occur, either from atrophic alteration, paralysis of an *opponent* muscle, or spasm in the muscle itself, caused by a lesion of the nerve. This last may take place without any atrophy. The spasm can be overcome by partial volitional control, but returns again. Tremor is present in some instances; the electric properties of the part are entire. Etherization relaxes the tonic contraction, and injections of atropia into the body of the muscle produce temporary or even permanent relief, which does not happen with the other forms of contraction.

No relation being strictly traceable between the atrophy present and the extent of the paralysis, there would appear to be in the muscles, "motor nerve fibres and nutrient nerve fibres." From the effects of spinal injuries, our authors are induced to refer the "animating centre" of the nutrient nerve fibres to the spinal column. They do not say spinal *cord;* does this mean to leave room for added or modifying influence of the *ganglia* outside of the cord? While asserting, however, that, as the consequence of nerve injury, the muscles may be paralyzed, sensation destroyed, or nutrition attacked, and declaring a belief that the "nutrient nerves" are *sympathetic* fibres, our authors decline, at this point, discussing the modus operandi of such a disturbing agency.

Paget, alone, is cited as having anticipated the history of the cases given to show the singular changes of the skin under nerve lesion. But Legouest[1] certainly describes similar phenomena; though somewhat less fully. He speaks of the pain attending them as extremely acute and obstinate, lasting sometimes the life of the patient, and, in regard to the appearances, "*la peau devient excessivement fine, et se colle, pour ainsi dire, sur les os; les articulations des membres s'enroidissent, &c.*" The description of Paget[2] is of "glossy fingers, tapering, smooth, hairless, pink, ruddy, or blotched as if with permanent chilblains," and affected with severe neuralgia.

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[1] Traité de Chirurgie D'Armée. Paris, 1863, pp. 878–9.

[2] Med. Times and Gaz., London, March 26, 1864.

Among fifty partial nerve injuries from gunshot, in the Christian Street Hospital, such symptoms occurred in nineteen. They do not belong to instances of complete destruction of the nerves; they have no definite time of commencement, nor term of duration. The palm of the hand and the dorsum of the foot are their most common seats. An eczematous eruption was a constant accompaniment of this state of things; in a few it alternated with the pain. The nails became much altered, showing a curve in the long axis, an extreme lateral arching and retraction of the skin of the third phalanx, exposing the matrix. No deformity of the nails in tuberculous patients approaches this. In the toes, ulceration sometimes occurred at the angles.

Pain always attended this state of things. It was, usually, of a very peculiar, burning character, probably dependent upon nutritive alteration of extremities of sensitive nerves.

A condition of the joints seldom described (*see* Legouest, cited above) in connection with nerve lesions, is characterized as closely resembling that belonging to subacute rheumatism. Allusion is made to the hypothesis suggested in this Journal[1] by the late Prof. J. K. Mitchell, that rheumatism is of spinal origin, as receiving a certain amount of support from these facts, showing rheumatoid symptoms clearly traceable to a neural source.

After complete section of the nerves of a limb, our authors report that the skin is commonly dry, while incomplete injuries affecting innervation give rise to very variable consequences in regard to the secretions. We may have occasion presently to revert for a moment to the subject of these statements. They found the line of perspiration, in some paralyzed cases, so accurately defining the edges of the sensitive skin, as to afford means of designating the nerve injured. Very acid sweats are recorded as occurring in one case of gunshot wound of the brachial nerves.

A chapter is given, in Dr. Mitchell's book, to the particular consideration of traumatic lesions of sensation. *Muscular* hyperæsthesia was several times witnessed in the Christian Street Hospital. Anæsthesia, as previously remarked, is a less frequent and less permanent symptom than motor paralysis, the explanation of which fact is not discerned. Legouest makes the same statement,[2] but equally without explanation. Earlier recuperation of sensory functions may, as our authors observe, be in part accounted for by the constant "automatic excitation" of the sense of touch in all parts exposed to external influences, while no such stimulus to impaired mobility occurs.

The only sufficient test of perfect paralysis of the cutaneous nerves is the *electric brush*. The bearing of the information thus obtained, upon prognosis, is obvious and important.

Not dwelling upon *darting*, neuralgic pain, and *aching*, both of which are common after wounds of nerves, special attention is devoted to the peculiar *burning* pain already mentioned. It seems to be generally superficial, is sometimes trivial, but often an extreme torture, affecting by sympathy the whole body, so as to disturb the general health. The part becomes exquisitely hyperæsthetic. The patient avoids even the least exposure to the air, keeping the surface constantly wet, rather for the effect of moisture than of coolness. Occasionally he grows "hysterical," the whole body acquiring a morbid sensitiveness to every movement. Two men found ease from pouring water into their boots, as if the vibrations in walking were thus diminished. Cold weather lessened these pains; heat, and hanging the part down, increased them. The temperature was always found to be higher at the seat of this burning sensation, than either in the surrounding parts, or at corresponding points on the other half of the body. This last is an interesting fact, when compared with some results of physiological experiments, in a theoretical aspect. Since nutrition is shown, by the "denuded and altered skin," &c., to be *impaired* in these cases, we have, in them, instances of increase of temperature with diminution of nutritive activity not easily reconciled with some of the propositions in regard to the influence of vaso-motor nerves on nutrition, made by Brown-Séquard.[1] Of this a word further hereafter. The writers who give the graphic accounts we are quoting (only too briefly) satisfied themselves "that the immediate cause of burning pain lies in the part where the burning is felt," the probable source of it being alterations in the circulation and nutrition of the tissues to which the extremities of the wounded nerve are distributed. The agents which give relief to the pain "are those addressed to the spot where it is felt, and not to the cicatrix." (p. 105.)

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[1] Am. Jour. of Med. Sciences, vol. viii. p. 55.

[2] Traité de Chirurgie D'Armée, p. 83.

A case is fully described in which, among other remarkable features, it is stated that sensibility was found to exist in the median distribution, thirty months after a portion of the nerve had been removed by Medical Inspector Pineo, U. S. A. Our authors are, in their question as to its reproduction, apparently unmindful of a mode of reunion probable in such a case; viz., the contact of the divided ends of the nerve, reunited by the contraction of cicatrization.

Many interesting remarks are made by Drs. Mitchell, Morehouse, and Keen, and illustrated by clinical examples, upon the subject of the influence of nerve lesions on motility. We may leave these at present, to be perhaps referred to again in connection with reflex paralysis.

A brief account only is given of some observations, carefully made, to determine the condition of calorification following injuries of nerves. Using, after disappointment with other means, Becquerel's thermo-electric disks, with a very delicate galvanometer, they found numerical comparison to be made impossible by the great amount of the differences; the needle moving to the limit of its arc of motion in nearly every case. The results, however, are not without interest.

The member, the nerves of which were affected, was nearly always colder than the other, whether the nerve lesion was extensive or trifling. In two cases there was no difference. Five had a higher temperature in the wounded limb; in all but one of these the burning pain existed. None of the cases thus examined had complete division of the nerves, except those of the seventh pair. In the only one of the latter which was tried no difference in heat was found between the two sides.

The concluding chapters in this work are valuable, especially on account of their positive statements in regard to the value of electricity—"faradization"—in the diagnosis, prognosis, and treatment of injuries of nerves. From a large and carefully-considered experience, they are ready to pronounce very favourably of its use. They confirm, almost without exception, the principles asserted by M. Duchenne.[1] By the presence or absence of electro-muscular sensibility (that property by which a muscle becomes the seat of pain when faradized) we can diagnosticate the degree of remaining innervation, and thus predict the probable ending of the case in recovery or hopeless paralysis. It is remarked that volitional control over a muscle may exist when it does not contract under electricity; and electro-muscular pain may be produced when faradization causes no motion at all.

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[1] Lectures, &c., p. 205, Prop. 12.

[2] Legouest, op. citat., p. 879.

Diagnosis in this mode is more easy after two or three months, when all the effects of *shock* are over, than soon after the wound. Continued and persevering faradizations are advised in doubtful cases, at long intervals; hoping, of course, in each case, for further repairs of nervous tissue and function.

Atrophies of muscles disappear, and local nutrition exhibits a singular stimulation, under the induced currents. They should be employed daily, for ten or fifteen minutes at a sitting; and it is remarked that "the treatment of atrophied muscles may be an affair of months, or even of years." Great confidence in the benefit of this treatment is expressed. With it, resort was also had, with frequent advantage, to the douche (alternately of hot and cold water), passive motion, and shampooing. The "burning pain" was most successfully treated by *blistering* the part with cantharides; sometimes again and again. No mere palliative seemed to do it more good than the patient's own instinctive method of keeping it wet all the time.

The paper on "Reflex Paralysis," by the same authors, was issued from the Surgeon-General's office, for the information of medical officers, in the belief that practical benefit might be derived from it.

As histories of sudden reflex paralysis from mechanical injuries, the reports therein given are thought by their writers to stand alone. Legouest, however, in the treatise already quoted, mentions some such examples;[2] and in Brown-Séquard's Lectures[3] cases are cited as mentioned by Whytt and Barthez, and one by Morgagni of a woman in whom amaurosis was instantly produced by a stroke upon the eyebrow by the beak of a cock. Still, no such complete account of these remarkable pathological conditions has been elsewhere given, and it forms a useful contribution to biology as well as to military surgery.

Such accidents as are here considered are rare; only seven cases have been distinctly recognized among all the wounds of nerves presented in the hospital devoted especially to affections of the nervous system. *Transient* reflex paralysis, from wounds on the battle-field, may, of course, often occur and be overlooked in the hurry and pressure acting upon surgeons, and which are seldom altogether over in the division or corps hospitals.

Before narrating the cases selected, this paper alludes to the various kinds of shock, commotion, &c., known to military surgeons, as well as to experimental physiologists, as occurring under powerful impressions made on the nervous system. Among the most curious of these is the sudden traumatic "hysterical" state, produced sometimes in the bravest men by the shock of a wound. An officer of well-known courage, in the Mexican war, was wounded in the heel; the nervous excitement following was such as to give him the appearance of the utmost trepidation. An apothecary, thrown down and suffering a rupture of the *membrana tympani* from an explosion of chemicals, became violently agitated as well as prostrated, with irregular action of the heart; for twenty-four hours he was unable to walk alone. The shock to the auditory nerve was supposed here to be the occasion of the disturbance of the system.

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[1] De L'Electricité Localisée.

[2] "*Nous avons vu survenir une paralysie complète de l'avant-bras et du bras, à la suite d'une saignée dans laquelle un des rameaux du nerf musculo-cutanée avait été coupé. Traité*, &c., p. 879.

[3] P. 158.

The state of "stupeur générale," as the French writers call it, following upon gunshot injuries, is, most probably, a general paralysis. Our authors then define the local affection to which they have given the most attention, thus: "When a wound occurs, and the patient surviving the first effect is found to have paralysis of a distant limb or limbs, it is impossible to deny to such cases the title of reflex paralysis." C. Handfield Jones, in the work named last at the head of this article, limits this term more narrowly; applying it only to cases in which the paralysis is of proved *irritative* origin, so as to be at once relieved by removal of the causative irritation. We cannot think, however, that this limitation is justified; even if a distinction be admitted, as it may be, pathologically, between such cases and those which the same able writer calls "paretic," being dependent upon permanent enfeeblement of nerve-centres.

Not having space for the full discussion of the very interesting cases described in the *Circular* before us, their nature may be apprehended from a statement of the main features of each.

"CASE I. Ball wound of right side of the neck, probably involving no important nerve directly; fracture of hyoid bone; wound of throat. Reflex paralysis of left arm. Probable reflex paralysis of right arm. Early recovery of left arm; partial and remote recovery of right arm."

"CASE II. Flesh wound of right thigh, without wound of any large nerve; complete paralysis of all four limbs; speedy recovery of the left arm, tardy recovery of the other limbs; subsequent analgesia of the right side."

"CASE III. Wound of right thigh, with probable commotion of right sciatic nerve; partial paralysis of right leg; reflex paralysis of right arm; speedy recovery of arm; history unfinished."

"CASE IV. Ball wound of right testicle; paralysis of right anterior tibial muscles and peroneus longus."

"CASE V. Wound by fragment of shell in external side of left thigh; paralysis of tact on a corresponding part of right thigh."

"CASE VI. Ball wound, probably involving the crural nerve. Paralysis of right arm resulting."

"CASE VII. Ball wound of deltoid muscle; sensory and slight motor paralysis of same arm."

No general law seems to be deducible from these records, as to the relation between the part injured and the nature or locality of the consequent paralysis.

Pain, of a stinging or burning kind, was an early but transient symptom in the part paralyzed, in four of the seven cases. Recovery from the reflex paralysis proceeded, rather rapidly, to a certain point; but some remainder of it was left in almost every case, even eighteen months after the injury. This is certainly curious, and very hard to explain.

But the whole theory of the mode of causation of reflex paralysis is a problem, involved, as yet, in great obscurity. All the materials before us, with the reasonings upon them, do not suffice to afford it an entirely satisfactory solution. Let us give attention for a few moments, on account of their biological as well as pathological interest, to the efforts made in this direction, by the different authors whose works are now under consideration.

Thus the subject is opened in the pamphlet of Drs. Mitchell, Morehouse, and Keen, p. 16:—

> "We have had no plausible theory of the causation of these effects, until M. Brown-Séquard attempted to account for them in a manner equally simple and ingenious. Recalling the fact that irritation of the vaso-motor nerves is capable of producing contraction of the bloodvessels, he inferred that when an external nerve is violently or permanently excited, it may be able to produce contraction of the capillary vessels of the nerve centres, and thus give rise to paralysis.
>
> "It seems unlikely, even if we admit this explanation, that the capillaries could remain contracted for any great length of time. But it is possible that the alteration of nutrition, which this temporary anæmia causes, may give rise to one of two results, either a continued disturbance of nutrition, which, however slight, would occasion grave results if it existed in a nerve centre, or secondly, to a paralysis of the capillaries of the nerve centre involved.
>
> "With so satisfactory an hypothesis before us in this modified shape, it might seem needless even to suggest any other explanation. But in a region of research so little explored, it may be allowable to point out the fact, that another mode of explanation is at least possible, and the more so, since there exist certain objections to M. Brown-Séquard's manner of viewing the subject."

It must be remarked here, that an exact presentation of Brown-Séquard's theory is hardly afforded in the paragraph above referring to it. He does not speak of an active or directly produced contraction of the *capillaries;* but expressly repudiates an hypothesis at one time proposed by Bernard, ascribing active properties to these vessels. He refers evidently, in regard to the influence of vaso-motor nerves, to the arteries; and although, by elasticity, the capillaries suffer contraction when less blood is driven through them, it is at variance with accepted histology in regard to them to speak, as our authors do, of a "*paralysis* of the capillaries."

Further, in the same paper, we have their own theory stated thus:—

> "If now we ask ourselves the question, whether it may be possible to blight or exhaust utterly the power of a nerve centre, without the intervening mechanism of contracted or dilated bloodvessels, we are tempted to think that such a result may be producible. It appears to us possible that a very severe injury of a part may be competent so to exhaust the irritability of the nerve centres, as to give rise to loss of function, which might prove more or less permanent. A strong electric current, frequently interrupted, is certainly able to cause such a result in a nerve trunk, while a general electric shock, as a stroke of lightning, is, as we well know, quite competent to destroy the irritability of every excitable tissue in the economy. While this view seems to us adequate to explain the facts, the notion of vaso-motor irritation and capillary contraction does not appear to be competent to cover *all* the facts."

Before expressing a preference for either of these views, it will be well to glance at the hypothesis implied in the term "inhibitory" nerve action, as dwelt upon in an early part of the work of C. Handfield Jones. A doctrine ascribed to. Pflüger, but rather hastily indulged or adopted by some other physiologists, is, that while some nerves convey an excitant force, which always increases the action of the organ to which it passes, others have the special province of diminishing, retarding, or, when acting most strongly, arresting the functional activity of certain organs. Lister, however, believes rather that "the same afferent nerve may, according as it is operating mildly or energetically, either exalt or depress the functions of the nervous centre on which it acts." Handfield Jones uses these words:

"It is not the energetic operation of an afferent nerve that causes inhibitory action; but, its being injuriously affected by some impression made upon it. The enfeebled state of the nerve itself, or of the centre to which it proceeds, or the severity or malignity of the impression, may give rise to the familiar effect." He gives, as an example, a case in which the external rectus muscle of the eye was paralyzed during the existence of a whitlow on the thumb; the paralysis and consequent squint disappearing after a piece of dead bone was removed from the diseased phalanx. Lawrence is quoted as relating a case in which the extraction of a carious tooth, with a splinter of wood projecting from one of its fangs, procured the restoration of the sight of the eye on the same side, which had been entirely lost for thirteen months. This is called by Dr. Jones "inhibitory action." Certainly with equal propriety it may be called reflex paralysis. The terms merely indicate diversity of theories, not difference in the facts.

Many other examples of this kind of action are to be found among the experiments of biologists;—as, when Bernard ascertained that irritation of the posterior roots of spinal nerves suddenly checks the cardiac motions for a time, while irritation of the anterior roots has no such effect; or, as Wilson Philip long ago proved, sudden crushing of the brain or destruction of the spinal cord arrests the arterial circulation more abruptly than does excision of the heart. In all such cases, of course, it is no speciality of functional relation, but the morbid character or extreme violence of the disturbing cause, that explains the "inhibition."

Briefly, Brown-Séquard's theory in regard to reflex paralysis is, that it is produced by *anæmia of nerve centres* due to *contraction* of the bloodvessels supplying it; this contraction having its origin in peripheral nervous *irritation.* Against this, Handfield Jones argues (*Clinical Observations, &c.*, p. 14) not very differently from Drs. Mitchell, Morehouse, and Keen; urging 1st, that it is difficult to suppose a spasm of reflex origin to be limited to such a very small extent of vessels as would be sometimes involved, as in palsy of one of the sixth nerves or ptosis of one eye. 2d, that it is almost impossible to believe that a contraction of vessels should be so persistent as the hypothesis requires. 3d, that Gull found irritation of the renal nerves not to cause contraction of the vessels of the spinal cord, nor paralysis of the lower limbs, as Brown-Séquard stated in explanation of paraplegia from renal disease.

These objections appear to us to be extremely well sustained. There is, as Dr. Mitchell avers, no experiment upon record to show that fixed contraction of bloodvessels can be made to continue for a length of time; nor any to prove that it occurs at all in any nerve-centre. To the contrary of the first of these hypothetical possibilities, we have the careful experiments of Wharton Jones;[1] in which, even under *direct* excitation, by electrical or other stimuli, the vessels were found, after contraction, to dilate either to or beyond their normal width. On this whole subject there is an amount of haziness in the reasoning of most writers, which, it must be admitted, does no great credit to biologists, and proves that able experimenters may sometimes fail to do complete justice to the solution of problems evolved by their own procedures. Let us illustrate this by an example bearing directly upon our present topic.

Brown-Séquard asserts the following summary proposition:[2] "The effects of excitation of the vaso-motor nerves consist essentially in a contraction of bloodvessels, which is followed by a diminution of the quantity of blood, in the temperature, and in the activity of nutrition. The effect of interruption of continuity of the vaso-motor nerves (*i. e.*, their paralysis) consists essentially in a paralytic dilatation of bloodvessels, which is followed by a greater afflux of blood, an increase of temperature, and a greater activity of nutrition."

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[1] Guy's Hospital Reports, 1851.

[2] Lectures, &c., p. 205, Prop. 12th.

Now this statement meets at once with important difficulties. Bernard showed[1] that, when certain nerves are excited, the bloodvessels of the salivary glands become *enlarged;* an increase in the secretion of saliva occurring also; and, a stimulation of the uterus, of the skin over the mamma, or of the mucous lining of the vagina, may produce a secretion of milk. Menstruation, too, has repeatedly been brought on by excitation of the mammæ by warm poultices. Brown-Séquard himself calls attention to these facts[2] as samples of reflex secretion. They cannot, however, be set down as examples of vaso-motor paralysis, reflex or otherwise. This explanation is boldly enough assumed by both Brown-Séquard[3] and Handfield Jones[4] for the familiar ophthalmic and sometimes facial congestion following the presence of a foreign body in contact with the conjunctiva. The former of these writers admits fully that many cases of reflex secretion require some other postulate. That which he assumes is based upon the theory so ably developed by Draper, of the "normal attraction of the living tissues for arterial blood;" it supposes that nervous excitation, sometimes, instead of producing fixed contraction by acting upon the *walls* of the vessels, may pass them altogether, and act upon the nutritive changes in the *tissues* so as to increase these changes, and thus draw more blood into the arteries, by the altered "suction-power" of the capillaries. Bernard was driven to a yet more clearly unphysiological conjecture;[5] that the *capillaries* may have two properties, one of contraction, and the other of dilatation; and that the first of these is put into play by one set of nerves, and the other by another set.

Why should either of these almost self-contradicting hypotheses be thought necessary? Are they not ingenious but inefficient modes of escaping the simple view, as to the arterial activity and its relations, propounded long ago by Unzer, but which has had only one decided advocate[6] since Sir Charles Bell? According to this view, the contractility of the arteries being, under normal excitation, as *rhythmic as that of the heart, only abnormal* irritation produces tonic contraction of the vessels, seldom or never permanent; while *paralysis* of the arteries, inducing their passive dilatation and blood accumulation (not active afflux) may follow either from the section of vaso-motor nerves, as in Bernard's division of the cervical sympathetic, or from an exhaustive or suppressive disturbance of vaso-motor nerve centres; and, at the same time, neither of these, nor any other mode of agency involving the bloodvessels primarily or especially, can account for reflex paralysis. Adopting this view, an argument in favour of which would be in this place obtrusive, we are driven to the conclusion stated, in different terms, by Dr. C. Handfield Jones, and by Drs. Mitchell, Morehouse, and Keen; that reflex paralysis or inhibitory action is caused by a morbid impression upon a nerve-centre, diminishing, if not exhausting its motor or sensory capacity, as a *neural* function, without any necessary reference to the condition of its bloodvessels. We cannot but be satisfied that this will be the finally accepted judgment of physiologists.

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[1] Journal de la Physiologie de l'homme, Oct. 1858.

[2] Lectures, &c., p. 155.

[3] Lectures, &c., p. 170.

[4] Clinical Observations, &c., p. 13.

[5] Journal de Physiologie, cited by Brown-Séquard, Lectures, &c., p. 149.

[6] Transactions of American Medical Association, 1856, pp. 781–837.

Very much more must be done, however, if not by biological experiment, at all events by close pathological observation, to elucidate this complex subject. Great credit is due to the medical officers who have carefully collated and ably analyzed facts having so great scientific as well as practical importance; and it may be hoped that their opportunities and labours will meet with further extension in the same direction, unless, indeed, this be prevented by the ever wished for cessation of the supply of material from the victims of war. H. H.

ART. XVII.—*Die Krankhaften Geschwülste. Dreiszig Vorlesungen gehalten während des Winter-Semesters* 1862–1863 *an der Universität zu Berlin.* Von RUDOLF VIRCHOW, ord. öff Professor der Pathologischen Anatomie, der Allgemeinen Pathologie und Therapie, etc. etc. Erster Band, mit 107 Holzschnitten und einem Titelkupfer. 8vo. pp. 543. Berlin: Hirschwald, 1863.

Morbid Tumors. Thirty Lectures delivered during the Winter Term of 1862–63 *at the University of Berlin.* By RUDOLF VIRCHOW, Professor of Pathological Anatomy, etc. etc. Vol. I. With 107 Woodcuts and a Frontispiece on Copper. 8vo. pp. 543. Berlin: Hirschwald, 1863.

THE learned Professor of the Berlin School thus comes before the public in another work, rich with the fruits of his own investigations, and full of that astuteness and logical simplicity in his deductions, which are characteristic of his gifted mind. We may well be glad that the walls of his lecture-room have been thus expanded so as to include even the far-off corners of the earth. Those of us who have enjoyed the opportunity of listening to his silvery utterances, will not fail to hear them ringing in our ears, as we peruse these pages, and will appreciate the force of that remark in the author's preface, where he says, it would be impossible to reproduce all the illustrations which were presented to his class. We can well imagine the hundreds of crayon sketches which were dashed off upon the blackboard with the readiness and skill of artistic genius. The work forms the first part of the second volume of *Lectures on Pathology;* those on Cellular Pathology forming the first volume. Like the latter, the present series are stenographic reports from the speaker's mouth, revised by him, and altered somewhat so as to adapt them to the press. The multitude of duties, both of a scientific and political character, banished from the Professor's mind all hope of producing any original work during that winter, save in this method. The present subject was chosen, partly because the author had devoted much reading and observation to it, partly because it was one in which the literature of our profession was, as it seemed to him, lamentably deficient, and partly because the views promulgated were, in his opinion, unsound. Differing from the humoral pathologists, he takes